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(71) Applicant(s)
Mercedes-Benz AG

(Incorporated in the Federal Republic of Germany)

136 Mercedesstrasse, D70327 Stuttgart, Federal Republic of Germany

Isoclima GmbH

(Incorporated in the Federal Republic of Germany)

Dauthendeystrasse 2, 81377 Munchen, Federal Republic of Germany

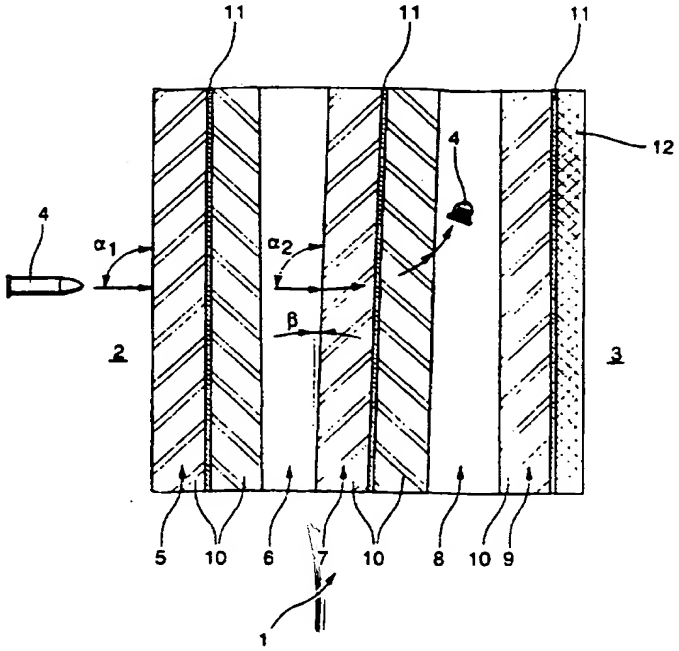
(72) Inventor(s)
Josef Schumacher
Peter Kruck

(72) cont
Christian Jauss
Herwig Woll

(74) Agent and/or Address for Service
Jensen & Son
70 Paul Street, LONDON, EC2A 4NA, United Kingdom

(54) Bullet-proof window with spaced, obliquely positioned laminated panes

(57) A bullet-proof window pane construction for a safety vehicle is composed of three laminated window panes 5,7,9 which are spaced apart from one another forming two fluid or gas filled gaps. At least one laminated window pane 7 is positioned obliquely relative to the adjacent panes 5,9 having the effect as to deflect the path of a projectile 4 within the window. The laminated panes are formed from at least one bullet-proof pane 10 and at least one other pane bonded to the first by means of a film 11. Also disclosed is a polycarbonate pane 12 used as the end pane on the inside of the window to prevent secondary splinters from impacting.



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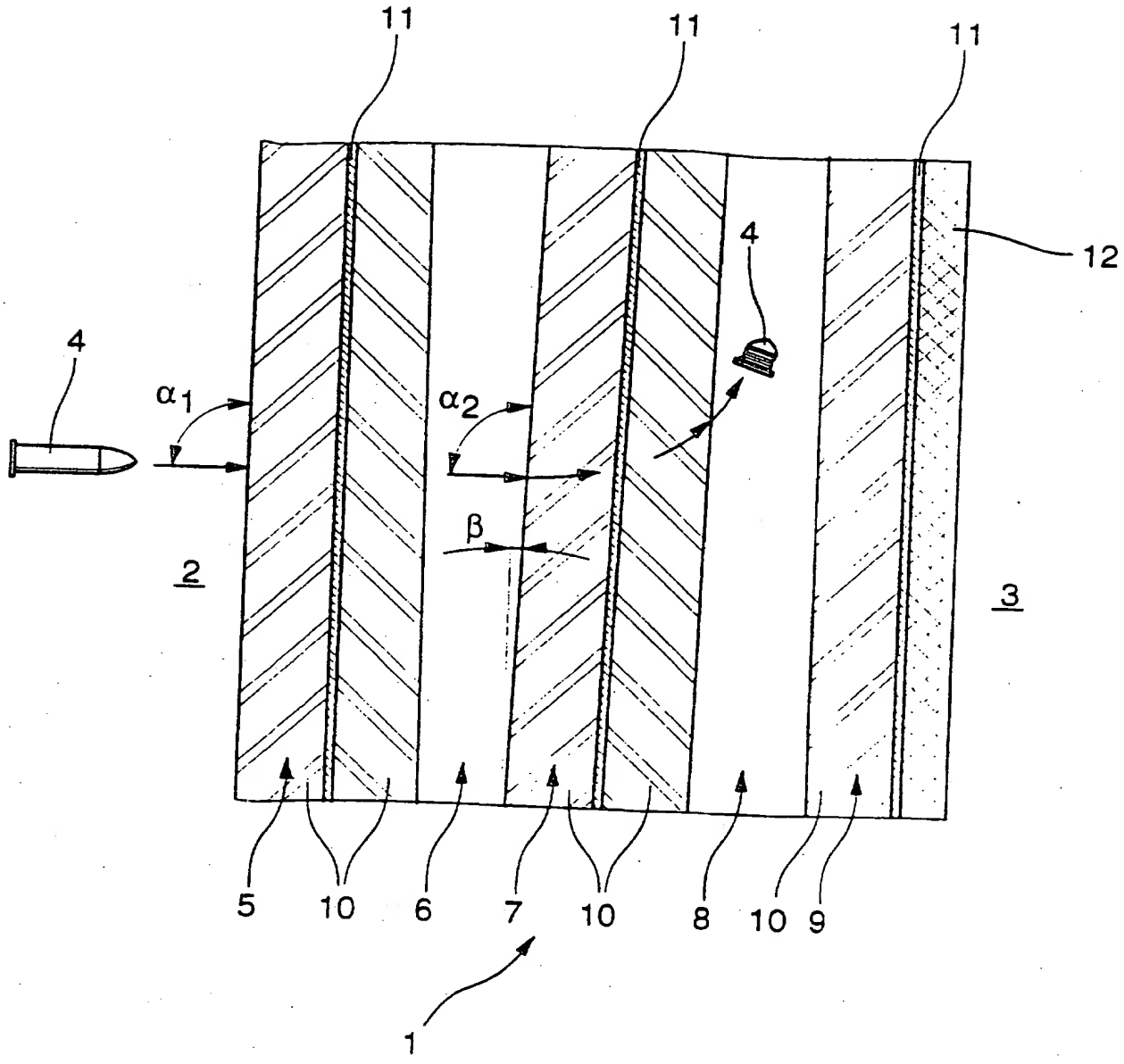

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Bullet-proof window pane construction for a safety vehicle

The invention relates to a bullet-proof window pane construction for a safety vehicle having at least two impact-impeding laminated window panes which are spaced apart from one another and between which at least one fluid-filled gap is provided.

A bullet-proof window pane construction of this type for a safety vehicle is disclosed in DE 42 36 233 A1. The bullet-proof window pane construction has a plurality of laminated window panes which are each composed of different panes and leave between them a gas-filled gap. Each laminated window pane is composed of at least two panes of a different type, in particular a bullet-proof glass pane and a polycarbonate pane which are bonded to one another in a flat manner with the aid of a film. All of the laminated window panes composed of a plurality of panes in the manner of a block are aligned parallel to one another with the result that the gas-filled gaps remaining between the laminated window panes are of the same thickness over their entire height. A projectile striking the bullet-proof window pane construction is deflected into the gas-filled gaps and, as a result, the distance for the projectile to penetrate the bullet-proof window pane construction is considerably lengthened. The penetration force is thereby reduced to such an extent that the projectile generally becomes stuck in one of the laminated window panes. However, if the projectile strikes the outermost pane of the bullet-proof window pane construction exactly at right angles the projectile is not deflected. In this particular case, under some circumstances the projectile may pierce the entire bullet-proof window pane construction and penetrate into the interior of the vehicle.

The present invention seeks to provide a bullet-proof window pane construction in which even in the particular case of a projectile striking at right angles the projectile is prevented from penetrating into the interior

of the vehicle.

According to the present invention there is provided a bullet-proof window pane construction for a safety vehicle having at least two impact-impeding laminated window panes which are spaced apart from one another and between which at least one gas- or liquid-filled gap is provided, the laminated window panes each being formed by at least one bullet-proof glass pane and at least one further pane bonded to the at least one bullet-proof glass pane by means of a film, the further pane being in the form of a further bullet-proof glass or plastics pane, wherein one laminated window pane is positioned obliquely relative to an adjacent laminated window pane.

The solution according to the invention causes the projectile to be deflected within the bullet-proof window pane construction, even if the projectile strikes exactly at right angles, since the projectile cannot strike the obliquely positioned laminated window pane at right angles. The oblique position of at least one laminated window pane relative to the adjacent laminated window pane causes different deflections of the projectile in each case, thereby resulting in an effective decrease in the projectile's energy.

In a refinement of the invention, a polycarbonate pane is provided as the side of the bullet-proof window pane construction on the inside of the vehicle. The use of a polycarbonate pane as the end on the inside of the vehicle prevents secondary splinters from impacting.

Further advantages and features of the invention emerge from the following description of a preferred exemplary embodiment of the invention which is illustrated by reference to the single drawing.

In a sectional representation, the drawing shows an embodiment of a bullet-proof window pane construction according to the invention having three laminated window panes which are arranged at a distance from one another in each case forming a gap.

The illustrated bullet-proof window pane construction is used in a safety vehicle and serves to shield the interior 3 of the vehicle from the outside environment 2 in a bombardment-impeding manner. The bullet-proof window pane construction 1 is composed of three laminated window panes 5, 7, 9 which are arranged spaced apart one behind another in relation to a firing direction of a projectile 4 fired from outside the vehicle. All of the laminated window panes 5, 7, 9 are designed in the manner of a block made from a plurality of sheets. Spacing apart the respectively adjacent laminated window panes 5, 7 and 7, 9 from one another results in two gaps 6, 8 between the laminated window panes 5, 7, 9, which gaps are filled with gas or with liquid.

The outermost laminated window pane 5 is composed of two bullet-proof glass panes 10 which are in the form of sheets and are bonded to one another in a flat manner by means of a film 11. In the same manner, the middle laminated window pane 7 is likewise composed of two bullet-proof glass panes 10 bonded to one another by means of a film 11. In the case of the laminated window pane 9, a bullet-proof glass pane 10 is bonded by means of a film 11 to a plastics, preferably polycarbonate, pane 12 which is likewise of sheet-like design and forms the side of the bullet-proof window pane construction 1 which is directed towards the interior 3 of the vehicle.

In the case of the bullet-proof window pane construction 1 according to this embodiment only the outer laminated window pane 5 and the inner laminated window pane 9 are aligned parallel to one another. The middle laminated window pane 7, in contrast, is positioned obliquely relative to the two laminated window panes 5 and 9, as a result of which the two gaps 6 and 8 are of a different thickness over their height. The middle laminated window pane 7 is positioned obliquely by an angle β relative to the two laminated window panes 5 and 9. As a result of this inclination of the laminated window pane 7 relative to the

adjacent laminated window panes 5 and 9, the projectile 4 is also deflected within the bullet-proof window pane construction 1 even if it strikes the outer bullet-proof glass pane 10 of the outer laminated window pane 5 at an angle α_1 of 90°. Although the projectile 4 then exits from the rear bullet-proof glass pane 10 of the laminated window pane 5 without changing direction, it strikes the subsequent bullet-proof glass pane 10 of the middle laminated window pane 7 at an angle α_2 which is different from α_1 and hence other than 90°. This angle α_2 differs from the angle α_1 by the extent that the laminated window pane 7 is positioned obliquely about the angle ß. The projectile 4 is thereby deflected within the middle laminated window pane 7 and on entering the subsequent gas-filled gap 8 is further deflected in the same direction of rotation. In the solution according to the invention, even if the projectile 4 strikes the outer laminated window pane 5 absolutely at right angles, the projectile 4 is therefore prevented from piercing through the entire bullet-proof window pane construction 1 and hence from penetrating into the interior 3 of the vehicle.

Claims

1. A bullet-proof window pane construction for a safety vehicle having at least two impact-impeding laminated window panes which are spaced apart from one another and between which at least one gas- or liquid-filled gap is provided, the laminated window panes each being formed by at least one bullet-proof glass pane and at least one further pane bonded to the at least one bullet-proof glass pane by means of a film, the further pane being in the form of a further bullet-proof glass or plastics pane, wherein one laminated window pane is positioned obliquely relative to an adjacent laminated window pane.

2. A bullet-proof window pane construction according to Claim 1, wherein the said one laminated window pane is formed by at least two bullet-proof glass panes bonded to one another by means of at least one film.

3. A bullet-proof window pane construction according to Claim 2, wherein a plastics pane is provided at the side of the bullet-proof window pane construction adapted to be on the inside of the vehicle.

4. A bullet-proof window pane construction according to any one of claims 1 to 3, wherein the plastics pane if formed of polycarbonate.

5. A bullet-proof window pane construction according to any one of claims 1 to 4, comprising three laminated window panes spaced apart with a gap between adjacent laminated panes, the middle laminated pane being arranged obliquely with respect to the other two laminated panes.

6. A bullet-proof window pane construction substantially as described herein with reference to, and as illustrated in, the accompanying drawing.

The Patent Office

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Application No: GB 9625752.2 **Examiner:** Richard Jupp
Claims searched: 1-6 **Date of search:** 10 February 1997

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.O): E1J: JA
E1R: RAX, RDR, RDT, RDV, RDX, RPP
F3C: CP2, CPK

Int Cl (Ed.6): B60J: 1/00
E06B: 3/00, 3/02, 3/04, 3/54, 3/64, 3/66, 5/00, 5/10, 5/11, 5/12
F41H: 5/00, 5/02, 5/04, 5/26, 7/00, 7/02, 7/04,

Other: Online: World Patents Index, JAPIO

Documents considered to be relevant:

Category	Identity of document and relevant passage		Relevant to claims
Y	GB1328576 A	(OASIS VACUUM GLAZING LIMITED) see figure 5, angled member 62	1-5
Y	US4633528 A	(RAYMOND W BRANDT) see figure 7	1-5
Y	US4368226 A	(GASPER MUCARIA) see 'description of invention', page 1, lines 3-6.	1-5
Y	DE4236233 A1	(BAYERISCHE MOTOREN WERKE AG) Whole document relevant	1-5
Y	DE4223538 C1	(DEUTSCHE AEROSPACE) see figure 1, angled member 7	1-5

X Document indicating lack of novelty or inventive step
Y Document indicating lack of inventive step if combined with one or more other documents of same category.
& Member of the same patent family
A Document indicating technological background and/or state of the art.
P Document published on or after the declared priority date but before the filing date of this invention.
E Patent document published on or after, but with priority date earlier than, the filing date of this application.

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Z

Application No: GB 9625752.2 **Examiner:** Richard Jupp
Claims searched: 1-6 **Date of search:** 10 February 1997

Category	Identity of document and relevant passage	Relevant to claims
Y	FR2639291 A (SAINT GOBAIN VITRAGE) see figure 1, angled member 4	1-5

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
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